



## Clinical practice

# Coronial autopsy in a rural setting



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## ABSTRACT

**Objectives:** To determine the precise nature of the non-homicide coronial autopsy.

**Design and setting:** Retrospective analysis of coronial autopsies between 2005 and 2011 in a rural setting on the Mid North Coast of New South Wales.

**Results:** A total of 1446 autopsies were performed during the 7 year study period. There were 1428 (98.75%) coronial and 18 (1.25%) hospital autopsies. Death in the coronial cases was attributed to natural causes in 829 (58%) of the cases, accidental causes in 321 (22.5%) of the cases, suicide in 244 (17%) of the cases and no apparent cause (indeterminate) in 34 (2.5%) of the cases. Acute myocardial ischaemia constituted 66.7% of the natural causes. Road traffic and other motorised vehicle-related accidents were responsible for 60.7% of deaths in the accidental group. The 2 main types of death in the suicide group were hanging (36.5%) and drug overdose (31.5%). In 34 deaths, the cause remained unclear, however, because of lack of suspicious circumstances and negative histology and toxicology, they were presumed to be due to natural causes.

**Conclusions:** The hospital autopsy has almost completely disappeared. On the other hand, coronial autopsies are on the rise. General Practitioners appear reluctant to issue death certificates in certain situations where there are no suspicious circumstances and the Coroners feel obliged to ask for autopsies. Currently, there is a severe shortage of pathologist and the additional coronial works adds to the burden on those pathologists who engage in such work. The coronial system needs to think about the role of the autopsy in these circumstances. Furthermore, additional resources from the various stakeholders are required for the increasing educational role of the coronial autopsy in undergraduate and postgraduate teaching.

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## 1. Introduction

In Australia, there are two types of autopsy, the hospital autopsy and the coronial autopsy. The hospital autopsy, which is performed at the request of the clinician who treated the deceased or the family, requires the written consent of the next of kin of the deceased, whereas the coronial autopsy is based solely on the coronial order and the permission of the next of kin is not required for a coronial autopsy.

The hospital autopsy rates, across most western countries, have been declining apparently because of technological advancements in clinical imaging and other investigative modalities, high costs, negative perceptions of the autopsy and issues surrounding family consent. The hospital autopsy plays an important role in clinical audit as it provides objective data on the ante-mortem diagnosis, the accuracy of the imaging/biopsy evaluation, effectiveness of the

therapeutic modalities and the appropriateness of the clinical management. Autopsies also make important contribution in terms of monitoring public health, diagnosing novel diseases, training health professional and providing information to the bereaved.<sup>1,2</sup>

In New South Wales, the coronial autopsy is performed when a person has died a violent or unnatural death, or has died suddenly and the cause is unknown. A coronial autopsy is also performed in situations when a medical practitioner declines to issue a certificate stating the cause of death, the deceased person was not attended by a medical practitioner within 6 months before death, a person died in circumstances where the person's death was not the expected outcome of a health related procedure, a person has died while being provided with care, treatment or assistance in certain establishments such as a hospital, residential centre, welfare facility or residential child care centre, or a person has died in police custody or while in a prison or a detention centre. The Coroner, in these circumstances conducts an inquest to determine the identity of the deceased and inquire into the date, place, cause and manner of death. The Coroner's inquest also serves to protect lives and

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wellbeing by bringing to the notice of relevant authorities any practices, policies or laws which could be changed to prevent similar deaths in the future.<sup>1,3</sup>

This article presents data from a rural setting in New South Wales over a period of 7 years and discusses the role of the coronial autopsy in medical education.

## 2. Materials and methods

The main catchment area of the study was the Mid North Coast of New South Wales. In 2010 and 2011, this catchment area also included the Far North Coast of New South Wales. Only unexpected death not deemed to be suspicious were included in the study. All suspicious deaths were referred to the nearest major forensic centres in New South Wales. Autopsies, arising from suspicious deaths (homicide) and highly infectious cases were not performed in this part of New South Wales. A full autopsy including examination of the three body cavities (cranial, thoracic and abdominal) was performed on most of the cases. The brain, on occasions, was not examined if such an examination was deemed to be unnecessary. All the major organs were sampled for histopathological examination in every case. Body fluid such as blood, urine, bile or ocular fluid and tissue such as liver were collected in all the cases. Gastric contents were also collected when appropriate. Material was sent for toxicological analysis in all the cases except when death was considered to be due to natural causes. In these cases a sample of blood was locally frozen and stored for 12 months.

## 3. Results

In the 7-year period, between 2005 and 2011, a total of 1446 autopsies were performed at the Manning Bases Hospital Mortuary in Taree, New South Wales. There were 1428 (98.75%) coronial and 18 (1.25%) hospital autopsies.

The hospital autopsies were carried out mostly on patient with relatively short hospital stay without a firm clinical diagnosis. In 4 cases the autopsy was performed at the request of relatives because the deceased had had a history of asbestos exposure. The hospital autopsies will not be considered further as they are not within the scope of this article and numbers are too small to provide meaningful information.

The average age for the coronial autopsies was 59 years (range of 3–99 years) and the male to female ratio was 2 to 1. Death was attributed to natural disease in 829 (58%) of the cases, accidental causes in 321 (22.5%) of the cases, suicide in 244 (17%) of the cases and unknown manner of death in 34 (2.5%) of the cases.

### 3.1. Natural causes

This group consisted of 829 individuals with an average age of 67 years (range of 14–99 years) and a male to female ratio of 2 to 1. Analysis of this group (Fig. 1) revealed acute myocardial ischaemia in 553 (66.7%), infection in 103 (12.5%), massive haemorrhage in 85 (10.3%), pulmonary embolism in 28 (3.4%), cancer in 21 (2.6%), aspiration in 14 (1.6%), bowel ischaemia in 12 (1.4%) and miscellaneous causes in 13 (1.5%) of the cases. The cardiac deaths were due to coronary artery disease in 526 (95.2%), congestive cardiomyopathy with a history of alcohol abuse in 20 (3.6%) and valvular disease (aortic stenosis) in 7 (1.2%) of the cases. Acute myocardial ischaemia secondary to atherosclerotic coronary artery disease was diagnosed when the lumen of at least one of the coronary arteries was narrowed by >80% in the absence of other significant illness which could cause death. Established myocardial infarction was rare, detected in only 20 (3.6%) of the cases with 18 (90%) presenting as cardiac tamponade. Undiagnosed infection mostly

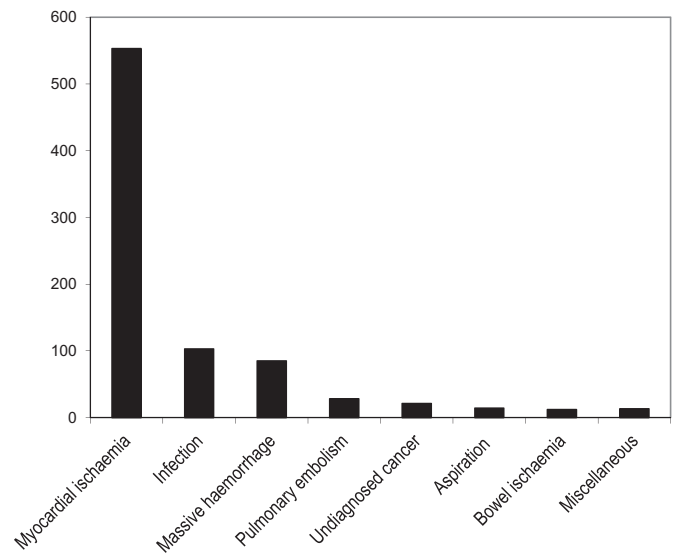
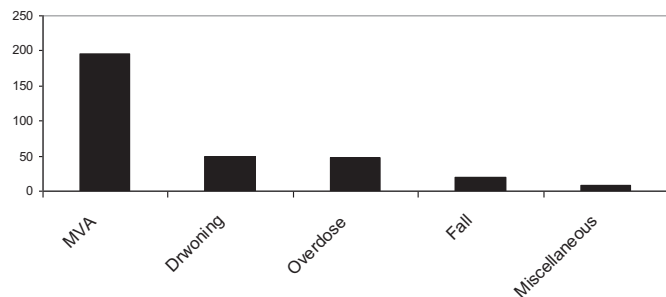


Fig. 1. Break down of the 829 natural causes into acute myocardial ischaemia (66.7%), infection (12.5%), massive haemorrhage (10.3%), pulmonary embolism (3.4%), cancer (2.6%), aspiration (1.6%), bowel ischaemia (1.4%) and miscellaneous causes (1.5%).

pulmonary (pneumonia) was noted in 68 (66%), peritonitis from bowel, gall bladder or pancreatic sources in 23 (22%) and septicaemia from unknown infection sources in 12 (12%) of the cases in this group. Septicaemia was confirmed by blood cultures. Of the 85 cases with massive haemorrhage, ruptured aneurysm was found in 63 (74.1%), oesophageal varices 11 (12.9%), peptic ulcer 10 (11.8%) and coagulopathy in 1 (1.2%) of the cases. The 63 ruptured aneurysms consisted of 51 (81%) aortic and 12 (19%) berry aneurysms at the bases of the brain. In the aortic aneurysm group, 46 (90%) were in the abdominal aorta and 5 (10%) in the thoracic aorta. Most of the 38 individuals who died of pulmonary embolism were nursing home residents. Moribund individuals for various reasons were also encountered in this group. Of the 21 cancers, 10 originated in the lung, 5 in the large bowel, 1 in the breast, 1 in the oesophagus, 1 in the stomach, 1 in the pancreas and 2 in the pleura (mesothelioma). The 14 individuals who died of food aspiration 10 had acute alcohol intoxication, 3 bowel obstruction and 1 motor neuron disease. Bowel ischaemia was due to arterial compromise (atherosclerosis) in 10 cases and venous obstruction (volvulus) in 2 cases. The miscellaneous group consisted of 4 cases of sudden unexpected death in epilepsy (SUDEP), 2 cases of severe bronchial asthma, 2 cases of chronic renal failure, 2 cases of amyloidosis, 1 case of Down syndrome and 1 cases of graft versus host disease following bone marrow transplantation.

### 3.2. Accidental causes

The average age was 46 years (range of 3–95 years) and the male to female ratio of 5:1. Analysis of the 321 accidental deaths (Fig. 2) revealed fatal road and traffic and other motorised vehicle-related accidents in 195 (60.7%), drowning in 49 (15.3%), drug and alcohol intoxication in 48 (15%), fall from a height in 20 (6.2%) and in 9 (2.8%) miscellaneous causes were encountered. In the motorised vehicle group, there were 163 car, 7 motorcycle and 3 speedboat and 1 truck accidents. In addition, there were 3 tractor, 2 bulldozer, 1 tipper and 1 quad bike accidents. In the fatal car accident group, there were 155 drivers and 11 passengers. Almost all the motor vehicle-related fatalities were involved 1 person but in 1 instance 2 individuals were killed. Forty five of the 49 cases of drowning took place in the sea with most being tourists, often from



**Fig. 2.** Break down of the 321 accidental cases into fatal road and traffic and other motorised vehicle-related accidents (60.7%), drowning (15.3%), drugs and alcohol intoxication (15%), fall from a height (6.2%) and miscellaneous causes (2.8%).

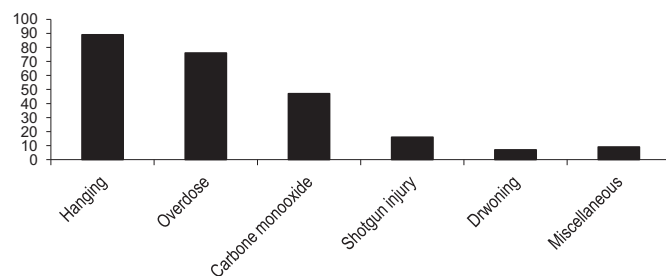
other countries. Accidental fresh water drowning was seen in 4 cases. Acute alcohol intoxication often in association with other recreational drugs was responsible for accidental death in 48 cases. In these deaths, aspiration of gastric contents was often noted. Fall from a building or a cliff were seen in 20 cases. The miscellaneous group consisted of 3 cases of death during autoeroticism, 3 electrocutions and 3 deaths from crush injury by a falling tree.

### 3.3. Suicide

The average age of the deceased was 47 years (range of 13–88 years) and the male to female ratio was 3 to 1. Death was due to hanging in 89 (36.5%), drug overdose in 76 (31.1%), carbon monoxide poisoning in 47 (19.3%), fatal shotgun injuries in 16 (6.5%), drowning in 7 (2.9%) and other (miscellaneous) causes in 9 (3.7%) of the cases (Fig. 3). History of mental illness was recorded in almost all the cases and a suicide note was often left. Hanging took places mostly at home, unusually in the garage but sometimes in the bedroom. Occasionally, hanging from a tree either in the backyard or in the bush was encountered. Drug overdose was attributed mostly to prescription medications. Carbon monoxide from car exhausts was a relatively common method of suicide. Drowning was infrequently seen. These were mostly in fresh water taking place in rivers (3 cases) and in dams (2 cases) but in 2 instances drowning took place in the sea. All deaths by shotgun took place on farms. The Miscellaneous cases included inhalation of Helium in 2 cases, liquefied petroleum gas (LPG) in 2 cases, jumping in front of a train in 2 cases, placing a plastic bag over the head in 1 case, strychnine poisoning in 1 case and driving a motor vehicle into an embankment in 1 case.

### 3.4. Unknown manner of deaths

The average age was 52 years (range between 21 and 83 years) and the male to female ratio of 1 to 1. Police information in the 34



**Fig. 3.** Break down of the 244 suicides into hanging (36.5%), drug overdose (31.1%), carbon monoxide poisoning (19.3%), fatal shotgun injuries (6.5%), drowning (2.9%) and other (miscellaneous) causes (3.7%).

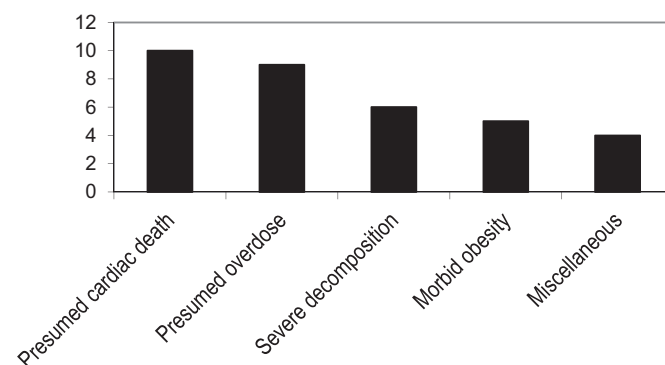
cases without an apparent cause indicated no suspicious circumstance and autopsy findings, microscopic analysis and toxicology results were non-contributory. Analysis of this group is shown in Fig. 4. In 10 (29.4%) of the cases, death was attributed to a cardiac cause (acute myocardial ischaemia) because the heart, in these cases was the only abnormal organ at autopsy. In all these cases, the heart weighed in excess of 400 g and usually showed left ventricular hypertrophy. Fatal arrhythmia was considered to be the final event in these cases. In 9 cases (26.5%), drug overdose was assumed to be cause of death despite non-contributory toxicology. This was based on information provided by the police at the scene of death. Severe decomposition did not allow determination of the cause of death in 6 (17.7%) of the cases. Morbid obesity without an anatomical cause was present in 5 cases (14.7%). The 4 (11.7%) miscellaneous conditions were associated with severe fatty liver (3 cases) and faecal impaction (1 case).

## 4. Discussion

The coronial autopsy is gradually being centralised in New South Wales with only small numbers of autopsies still being performed in regional towns.<sup>4</sup> The coronial autopsy services in the North Coast of New South Wales which were being performed in Lismore and Taree, ceased in late 2011. This centralisation, in part was due to a lack of resources in terms of appropriate mortuary facilities and shortage of pathologists in these regional areas. It was also part of the move to centralise these services in 2 main centres in New South Wales.<sup>4</sup>

Pounder et al. have been calling for reduction in the number of coronial autopsies and advocating external examination of the body only in the majority of the cases. They describe the philosophy and practice of the Scottish system of post-mortem external examinations, and their 20-year experience of the local initiative to maximise use of such external examinations. While they agree that the autopsy is an important tool in modern death investigation, an almost automatic recourse to it is inappropriate. They believe that external examinations are not only cost-effective but are also a necessary element in any death investigative system which wishes to strike an appropriate balance between intrusion by the state and the rights of the bereaved.<sup>5</sup>

Studdert and Cordner during a retrospective analysis of deaths reported to coroners in Australia between 1 July 2000 and 31 December 2007, using the National Coroners Information System stated that coronial investigations transform basic understanding of cause of death in only a small minority of cases. However, they



**Fig. 4.** Break down of the 34 cases with unknown manner of death into presumed cardiac cause (29.4%), presumed drug overdose (26.5%), severe decomposition, not allowing determination of the cause of death (17.7%), morbid obesity without an anatomical cause (14.7%) and miscellaneous conditions such as severe fatty liver and faecal impaction (11.7%).

believe that benefits to families and society of accurate cause-of-death determinations in these difficult cases may be considerable.<sup>6</sup>

Carpenter and Tait in an interesting article examine the tension between legal and medical discourses within the coronial system. Medical expertise, based largely upon internal autopsy, becomes positioned as providing the more important information, rather than the legal model which focuses on evidence gathering at the scene. They examine the aspects of the history, philosophy and consequences of the processes by which the medical model gained its current dominance and conclude by stating while autopsies are necessary; they are also over-used in the coronial system.<sup>7</sup>

The North Coast of New South Wales is a not only holiday destination for many Australian and overseas visitors but it is also home to many retirees because of its mild climate. The data, in this article reflects these facts with cardiac deaths and deaths from motor vehicle accidents and drowning being highly represented. Many of the people who drowned were visitor to the area, often from other countries with little knowledge of the local beach and surf conditions and sometimes unable to swim. The decomposed cases were all elderly, living alone and not being discovered for several days after death.

The high number of deaths from natural causes was attributed in part to the reluctance of general practitioners to issue death certificates. This may be partly due to cultural change in the general practitioner community as well as demographic changes with population movement to the coast in search of a milder climate, creating a somewhat transient population. Because of this somewhat mobile patient and doctor populations, General Practitioners, often do not know their patients very well, hence the reluctance in issuing death certificates. Deaths in nursing homes are also highly represented in the coronial autopsies. The explanation in this subgroup may be slightly different and potential for litigation by the family of the deceased for suboptimal care may be a factor weighing on the General Practitioner's mind in these circumstances.

Because of the demise of the hospital autopsy, the coronial autopsy has been assuming an increasing role in the education of medical allied health students.<sup>1</sup> This certainly was cases in this instance as students from the University of New South Wales who were based at the Port Macquarie and Coffs Harbour campuses regularly attended these post-mortems, as part of the university's requirement. Nursing, physiotherapy, pharmacology and other Allied Health students from other university, who were based in the catchment area, also attended these post-mortems regularly. Worldwide, Basic Sciences such Anatomy and Pathology have all but disappeared from most medical curricula, with negative impact

on proper understanding of disease processes. Common diseases seen in the community and the hospital setting such as cardiovascular diseases were highly represented. Other conditions such as undiagnosed infection and cancer were infrequently seen. Although students benefited from seeing the macroscopic attributes of disease processes, they were particularly interested in normal anatomy and the anatomical relationship between the various organs as they had only seen organs in photographs or in museum containers.

In summary, the coronial autopsy has almost completely replaced the hospital autopsy in the area of undergraduate and postgraduate teaching. This new role will require additional resources from Health Authorities and associated Universities. Currently there is a significant shortage of pathologists who are struggling with their routine work let alone perform coronial autopsies. For reasons described above general practitioners feel reluctant in issuing death certificate in certain circumstances with consequences for coronial autopsy. The Coroners need to think about the role of the autopsy in circumstances where there are no suspicious circumstances about the death.

#### Conflict of interest

No conflict of interest is envisaged.

#### Funding

No financial gains to declare.

#### Ethical issues

No ethical issues are expected.

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